

Index of late frost risk

Basis

Implementation of the calculation of the index IS for the late frost risk of trees according to Czajkowski and Bolte (2006). The index is calculated for a time span of several years.

Five variables are calculated:

- Ind1: **mean number of days** with late frost since beginning of the vegetation period ($T > 10^\circ$) or
- Ind1_sp **mean number of days** with late frost since bud burst of the simulated tree species
- Ind2: mean minimum May temperature
- Ind3: absolute minimum May temperature of the period
- Ind4: mean date of the last late frost event
- Ind5: date of the last late frost event of the period

Table 1 Classification into 6 levels

Risk	Level IS	Ind1[d]	Ind2 [°C]	Ind3 [°C]	Ind4 [date/DOY]	Ind5 [date/ DOY]
very low	1	until 2.5	until -1.5	until -5	< 10.5/130	< 5.6./156
low	2	2.6-3.5	-1.6- -2.0	until -6	< 15.5/135	<10.6./161
medium	3	3.6-4.5	-2.1 - -2.5	until -6	16.-20.5/135-140	11.-15.6./162-166
moderately high	4	4.6 -5.0	-2.6- 3.0	until -7	21.-25.5/141-145	16.-20.6/167-171
high	5	5.1-5.5	-3.1- -3.5	until -8	21.5.-25.5/141-145	21.-25.6./172-176
very high	6	>5.5	<-3.5	< -8	> 25.5/145	>25.6./176

Calculation of the total index **IS** or **IS_sp**:

- combination of Ind1 – Ind5 with logical ‘and’
- realised:: averaging Ind1-Ind5 (IS), and. Ind1_sp-Ind5 (IS_sp)

Two additional Indices are calculated as following according to (Riek et al., 2013), see

http://www.forstliche-umweltkontrolle-bb.de/r3_klima.php:

- ANZDLF: number of days with minimum temperature $< 0^\circ\text{C}$ from April until June
- SUMTLF: temperature sum of minimum temperature $< 0^\circ\text{C}$ from April until Jun2

Estimation of a further late frost risk index **LFI_{sp}** for deciduous tree species from model variables during a simulation time of N years:

1. calculation of variable LFI_{sp} per year i und per tree species sp:

$$LFI_{sp}(i) = \begin{cases} 1 & \text{daybb}_{sp}(i) < \text{date_lft}(i) \\ 0 & \text{else} \end{cases}$$

2. calculation of the index for the simulation period:

$$LFI_{sp} = \frac{\sum_{i=1}^N LFI_{sp}(i)}{N}$$

References

- Czajkowski, T. and Bolte, A., 2006. Frosttoleranz deutscher und polnischer Herkünfte der Buche (*Fagus sylvatica* L.) und ihre Beeinflussung durch Trockenheit. Archiv f. Forstwesen u. Landsch.ökol., 40(3): 119-126.
- Riek, W., Kallweit, R. and Russ, A., 2013. Analyse der Hauptkomponenten des Wärmehaushalts brandenburgischer Wälderauf der Grundlage regionaler Klimaszenarien – Abgrenzung von Risikogebieten und Schlussfolgerungen für ein Klima-Monitoring. Waldökologie, Landschaftsforschung und Naturschutz(13): 17-32.